

## SECTION 5 (14.00 - 14.45): The Product Development Process

What are the stages of product development?



DTU Management Engineering  
Department of Management Engineering

## 5<sup>th</sup> Section - Learning objectives

To be able to:

1. **List** the benefits of a formalised product development process.
2. **Explain** what is meant by a stage-gate process.
3. **Determine** which development process models are most suitable.
4. **Formulate** a complete process model for your project.

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## Why formalise a Product Development Process?

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## The benefits of a well formed process

- **Quality Assurance:** provides checkpoint for the process
- **Coordination:** exchange of information
- **Planning:** milestones, completion of planning schedule
- **Management:** process to benchmark ongoing process
- **Improvement:** careful documentation of organisation development process used to identify areas of improvement

Establishing a need/  
Conceiving idea

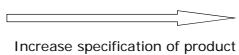


Commercialise product

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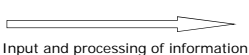
## What do Process Models consider?

Many **alternative product concepts**



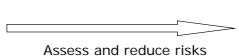
Reliable product

**Information processing**



Information required to support production and sales created

**Risk Management:**  
Various risks



Confidence in product functions and that well received in market

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## Product Development Process Models

Model	Establishing a need phase	Analysis of need phase	Conceptual design phase	Embodiment design phase	Detail design phase	Implementation phase
Brown et al. (1987)	X	New product strategy development	Screening & evaluation	Business analysis	Development	Testing
Amador (1988)	X	Programming, idea collection	Analysis	Development	Communication	Manufacture
Bransford (1974)	Need	X	Concepts	Verification	Decisions	X
Wilson (1988)	Societal need	Recognize & describe	Form & generate	Ideas and create	Analyze and test	Produce, prototype, process
Ulrich and Eppinger (1985)	Opportunity identification	Design	Conceptual design	Embodiment design	Detail design	Manufacture
VDA 2222 (1982)	X	Planning	Conceptual design	Embodiment design	Detail design	X
Holm and Biele (1982)	X	X	Conceptual design	Embodiment design	Detail design	X
Chen et al. (1984)	X	Strategy planning	Conceptual design	Embodiment design	Detail design	Manufacture
Pull and Biele (1984)	Task	Clarification of task	Conceptual design	Embodiment design	Detail design	X
French (1985)	Need	Analysis of problem	Conceptual design	Embodiment design	Detail design	Manufacture
Roy (1987)	Recognize problem	Explore of solution	Search for alternative	Product definition	Test for feasibility	Implement
Cooper (1988)	Ideation	Preliminary investigation	Detailed investigation	Development	Testing & validation	Full production & market launch
Johnson et al. (1988)	Recognition of need	Investigation of need	Product principle	Product design	Production preparation	Production
Hugh (1988)	Market	Specification	Concept design	Concept design	Detail design	Manufacture
Baker (1989)	Min. need, progress, test	Task clarification	Conceptual design	Embodiment design	Detail design	Manufacture
Baker (1989)	Assess information opportunity	Product principle	Product principle	Product principle	Product principle	Product principle
Ulrich and Eppinger (1985)	X	Strategy planning	Conceptual design	Embodiment design	Detail design	Manufacture
Ulrich (1987)	Identify	Plan for the need	Develop engineering specification	Develop concept	Develop product	Production
BST/BSI (1987)	Concept	Feasibility	Implementation (or realization)	Termination		
Black (1986)	Brainstorming	Review of 'state of the art'	Synthesis	Experimentation	Analysis	Decision to continue
Chen (2000)	X	Exploration	Generation	Evaluation	Communication	X
Design Council (2000)	Discover	Define	Develop	Deliver		X
Johnson et al. (1988)	Mission statement	Market research	Idea phase	Concept phase	Feasibility phase	Production

Howard, T. J., Culley, S. J., & Dekoninck, E. (2008). Describing the creative design process by the integration of engineering design and cognitive psychology literature. Design Studies, 29, 160-180.

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# What is a stage-gate process?

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## Product Development Process

Stage-gate model R. Cooper

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## Decision Gates in Drug Development

Key decision gates in drug development (adapted from Pritchard, 2003)

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## Product Development Process at a Project Level

The product planning phase precedes the product development process.

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## Drug Discovery and Development Process

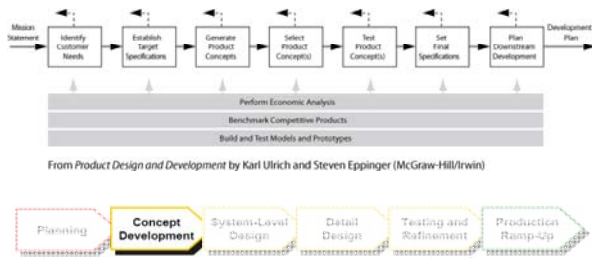
PRE-Discovery	DRUG DISCOVERY	PRECLINICAL	CLINICAL TRIALS			REG REVIEW	MARKETING
	5,000-10,000 Compounds	250	5				
			PHASE 1	PHASE 2	PHASE 3		
			NUMBERS OF VOLUNTEERS				
			20-100	100-500	1,000-5,000		
			IND SUBMITTED				
			6-7 YEARS				
			NDA SUBMITTED				
			3-6 YEARS				
						ONE APPROVED DRUG	
						1/2 - 2 years	
							PHASE 4: POST MARKETING SURVEILLANCE

The drug discovery and development process (adapted from Pharmaceutical Industry Profile, 2009)

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## Concept Development

The activities below are not always linear in fashion. The activities may overlap in terms of **time** and **iteration (repetition)** is often necessary due to new information or results.



## Drug Discovery Process

### Drug discovery

- 1) Selection and validation of target areas for drug research - how and why a certain drug mechanism or target is chosen and validated?
- 2) Drug synthesis and drug characterisation
- 3) Pharmacology: drug screening of potential development candidates, efficacy evaluation and preclinical safety
- 4) Drug formulation, analysis and stability for entry into man
- 5) Costs assessment - is there sufficient market potential and profit to justify drug development?
- 6) Toxicology of a drug including acute/subacute/chronic toxicology, teratology, mutagenicity, carcinogenicity

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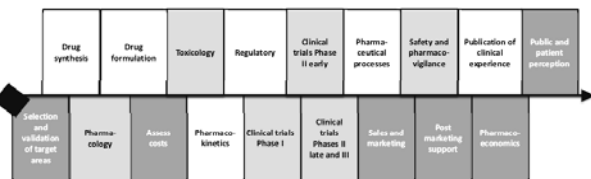
## Drug Development Process

### Drug development

- 7) Pharmacokinetics: preclinical (and later clinical drug absorption, distribution, metabolism and excretion)
- 8) Regulatory processes: conducting clinical trials, compiling drug dossier, submission, regulatory assessment
- 9) Phase I / First Time in Humans: pharmacokinetics, early pharmacodynamics
- 10) Phase II early: proof of concept and efficacy
- 11) Phase II late and Phase III: establishing dose relationship of effect and against comparator
- 12) Pharmaceutical processes: scale up, packaging and distribution
- 13) Sales and marketing of approved drug in the market place
- 14) Safety and pharmacovigilance of marketed drug
- 15) Post-marketing support of marketed drug with scientific and medical information
- 16) Publication of clinical experience with newly approved drug
- 17) Pharmacoeconomics of new drug, price reimbursement etc
- 18) Public's and patient's perception of new drug

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## Drug Discovery and Development Process



### X Process

Well regulated, often reason for failure, can be outsourced

### X

Considered highly important for assessment of Benefit and Risk  
Well regulated, often reason for failure, can be outsourced

### X

Considered highly important for entrepreneurial attitude  
Core in-house skills

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## Concept Development

### IMPACT OF EARLY, SHARP PRODUCT DEFINITION

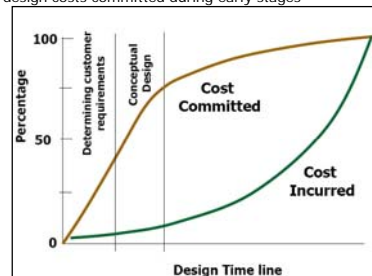


Source: RG Cooper, Winning at New Products

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## Costs Committed Product Life Cycle

Majority of design costs committed during early stages



David G. Ullman, 1997, *The Mechanical Design Process*, 2nd Edition, McGraw-Hill

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## Adapting the Product Development Process

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## Adapting the Product Development Process (Also see slides 4&5 of section 3)

Process Type	Description	Distinct Features	Examples
<b>Generic (Market-Pull) Products</b>	The team begins with a market opportunity and selects appropriate technologies to meet customer needs.	Process generally includes distinct planning, concept development, system-level design, detail design, testing and refinement, and production ramp-up phases.	Sporting goods, furniture, tools.
<b>Technology-Push Products</b>	The team begins with a new technology, then finds an appropriate market.	Planning phase involves matching technology and market. Concept development assumes a given technology.	Gore-Tex rainwear, Tyvek envelopes.
<b>Platform Products</b>	The team assumes that the new product will be built around an established technological subsystem.	Concept development assumes a proven technology platform.	Consumer electronics, computers, printers.
<b>Process-Intensive Products</b>	Characteristics of the product are highly constrained by the production process.	Either an existing production process must be specified from the start, or both product and process must be developed together from the start.	Snack foods, breakfast cereals, chemicals, semiconductors.
<b>Customized Products</b>	New products are slight variations of existing configurations.	Similarity of projects allows for a streamlined and highly structured development process.	Motors, switches, batteries, containers.

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### Technology-Push Products

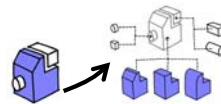
- A firm begins with a new technology, then finds an appropriate market
  - the post-it note
  - Gore-Tex Rainwear
- Planning phase involves matching the technology to the market
- Technology fixed for concept stage



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### Platform Products

- A firm assumes that the new product will be built around an established technological sub-system
  - Consumer electronics, computers, printers
  - PT Cruiser – Dodge Neon
- Concept phase, assumes a proven platform



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### Process-Intensive Products

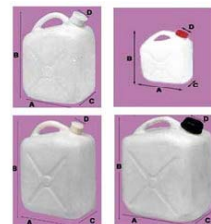
- Characteristics of the product are highly constrained by the production process.
- Both the product and the process must be developed together from the very start, or an existing production process must be identified first
  - Frito-Lay snack foods, chemicals, semi-conductors, computer memory



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### Customised Products

- New products are slight variations of existing configurations.
- Examples include:
  - Switches
  - Motors
  - Batteries
  - Containers



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## Case Study. AMF Bowling

### Product

- Bowling equipment, includes pin spotters, ball returns, scoring equipment
- Market-pull enterprise- seeks out technology required

### Competitive advantage

- Strong marketing
- Brand recognition
- Large installed base of equipment- no single technology

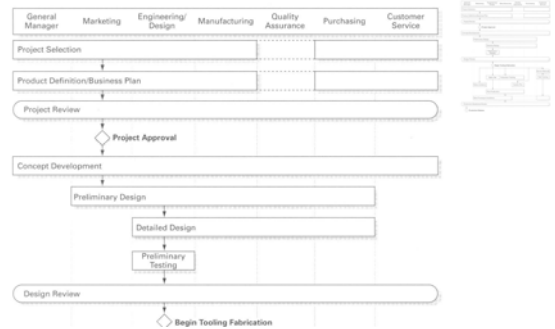
### AMF Products

- Assembled use traditional manufacturing methods: moulding, casting, machining, manufacturing
- Non-customised products,
- Development work- create new models rather than customise existing products



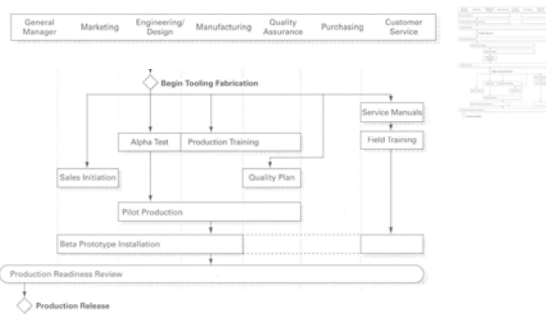
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## Case Study. AMF Bowling



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## Case Study. AMF Bowling



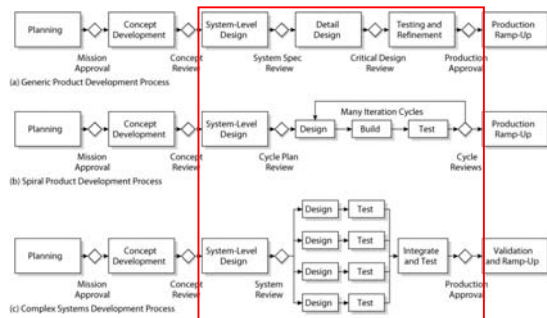
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## Adapting Generic Product Development Process

Process Type	Description	Distinct Features	Examples
High-Risk Products	Technical or market uncertainties create high risks of failure.	Risks are identified early and tracked throughout the process. Analysis and testing activities take place as early as possible.	Pharmaceuticals, space systems.
Quick-Build Products	Rapid modeling and prototyping enables many design-build-test cycles.	Detail design and testing phases are repeated a number of times until the product is completed or time/budget runs out.	Software, cellular phones.
Complex Systems	System must be decomposed into several subsystems and many components.	Subsystems and components are developed by many teams working in parallel, followed by system integration and validation.	Airplanes, jet engines, automobiles.

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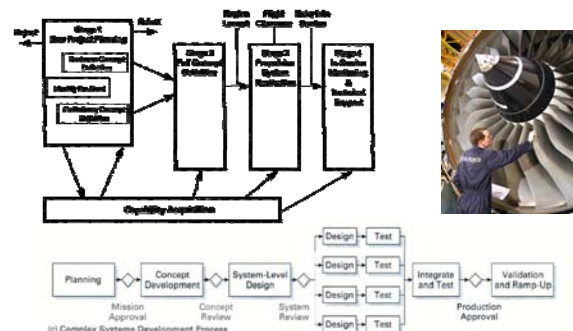
## Product Development Process Type



From Product Design and Development by Karl Ulrich and Steven Eppinger (McGraw-Hill/Irwin)

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## Rolls-Royce: The Derwent Process



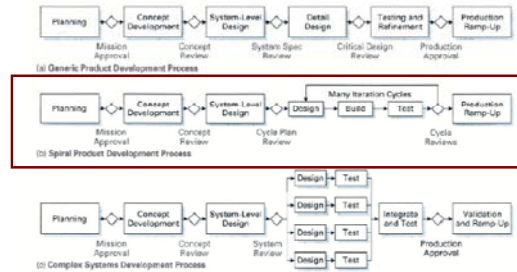
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## GN Product Development Process



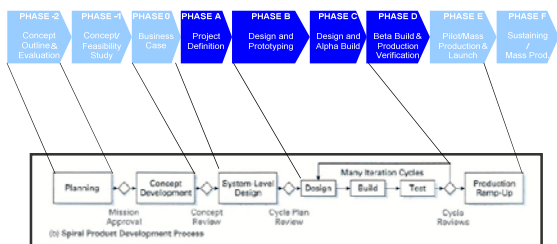
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## GN PDP and spiral process



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## GN PDP and spiral process



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## Summary

### Product development process:

- May differ from generic process (generic applies to market –pull)
- Depends on type of product and industry
- Is affected by global product development which is increasingly common/necessary

### Meeting the learning objectives?

To be able to:

1. List the benefits of a formalised product development process.
2. Explain what is meant by a stage-gate process.
3. Determine which development process models are most suitable.
4. Formulate a complete process model for your project.

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## Exercises (in pairs)

- 1) What do you think would be a suitable adaptation to the standard linear stage-gate process for your type(s) of project (slide 28, 29)?
- 2) Create an outline process model for your development project. Include stages (what are the activities and outputs) and gates (what will be selected)
- 3) Write 3 questions that you will ask of your project company in add more detail to your process model.

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Any Questions ?

15min break –  
back by 15.00

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